

## PATENT ABSTRACTS OF JAPAN

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### CLAIMS

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#### [Claim(s)]

[Claim 1] The electrode active material of the nonaqueous battery using lithium-nickel multiple oxide ( $\text{Li}_x\text{Ni}_y\text{N}_z\text{O}_2$ , N is elements except Li, Ni and O,  $0.8 < x < 1.2$ ,  $0.8 < y+z < 1.2$ , and  $0 \leq z < 0.2$ ) coated with lithium-transition-metals M multiple oxide (M is at least one sort of Co, Mn, and Fe, and including a small amount of Ni).

[Claim 2] The manufacturing method:

1. The compound of transition-metals M (M is one or more sorts of Co, Mn, and Fe, and including a small amount of Ni) and lithium compound are dissolved or suspended in a solvent.
2. Lithium-nickel multiple oxide expressed by the general formula  $\text{Li}_x\text{Ni}_y\text{N}_z\text{O}_2$  (N is other than Li, Ni, O,  $0.8 < x < 1.2$ ,  $0.8 < y+z < 1.2$ , and  $0 \leq z < 0.2$ ) is added into above solvent.
3. The slurry is dried and calcinated.

[Claim 3] The nonaqueous electrolyte battery using the electrode active material according to claim 1 for the positive electrode or the negative electrode.

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### DETAILED DESCRIPTION

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#### [Detailed Description of the Invention]

[The propose of this Invention]

To improve the cycleability of a battery.

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**[Example 1]**

1. Lithium-hydroxide monohydrates 83.9g + Nickel hydroxide 185.4g  
(atomic-ratio Li/Ni(mole ratio) =1.0)
2. Mill and mix it with ball mill.
3. Dry at 150 degree C for 12 h.
4. The mixture was calcinated at 750 degree C for 5 h in oxygen ambient atmosphere.
5. Mill it for 1 h with ball mill in nitrogen ambient atmosphere.  
The average particle size of lithium nickel multiple oxide is 7 um.
6. Ethanol 300g + Lithium nitrate 3.4g + Cobalt nitrate hexahydrate 14.6g  
(atomic-ratio Li/Co(mole ratio) =1.0)
7. The mixture + Lithium nickel multiple oxide 92.7g  
(atomic-ratio Co/Ni(mole ratio) =0.05)
8. Dry the dispersion with Spray dryer which the temperature of the spray exit is 100 degree C.
9. Calcinate it at 700 degree C for 1 h in oxygen ambient atmosphere.

**[Example 2]**

1. Lithium-nitrate 137.9g + Nickel hydroxide 185.4g  
(atomic-ratio Li/Ni(mole ratio) =1.0)
2. Mill and mix it with ball mill.
3. Dry at 150 degree C for 12 h.
4. The mixture was calcinated at 700degree C for 10 in oxygen ambient atmosphere.
5. Mill it for 1 h with ball mill in nitrogen ambient atmosphere.  
The average particle size of lithium nickel multiple oxide is 12 um.
6. Ethanol 300g + Lithium hydroxide monohydrate 2.1g + Cobalt nitrate hexahydrate 14.6g  
(atomic-ratio Li/Co(mole ratio) =1.0)
7. The mixture + Lithium nickel multiple oxide 92.7g  
(atomic-ratio Co/Ni(mole ratio) =0.05)

8. Dry the dispersion with Spray dryer which the temperature of the spray exit is 100 degree C.
9. Calcinate it at 700 degree C for 1 h in oxygen ambient atmosphere.

**[Example 3]**

1. Lithium hydroxide monohydrate 83.9g + Nickel hydroxide 166.9g + Aluminum hydroxide 15.6g  
(atomic-ratio Li/Ni/Al(mole ratio) =1.0/0.9/0.1)
2. Mill and mix it with ball mill.
3. Dry at 150 degree C for 12 h.
4. The mixture was calcinated at 750 degree C for 5 h in oxygen ambient atmosphere.
5. Mill it for 1 h with ball mill in nitrogen ambient atmosphere.
6. Ethanol 300g + Lithium hydroxide monohydrate 2.1g + Cobalt nitrate hexahydrate 14.6g  
(atomic-ratio Li/Co(mole ratio) =1.0)
7. The mixture + Lithium nickel multiple oxide 92.7g  
(atomic-ratio Co/Ni(mole ratio) =0.05)
8. Dry the dispersion with Spray dryer which the temperature of the spray exit is 100 degree C.
9. Calcinate it at 700 degree C for 1 h in oxygen ambient atmosphere.

**[Example 4]**

1. Lithium hydroxide monohydrate 83.9g + Nickel hydroxide 166.9g + Cobalt carbonate 137.0g  
(atomic-ratio Li/Ni/Co(mole ratio) =1.0/0.9/0.1)
2. Mill and mix it with ball mill.
3. Dry at 150 degree C for 12 h.
4. The mixture was calcinated at 750 degree C for 5 h in oxygen ambient atmosphere.
5. Mill it for 1 h with ball mill in nitrogen ambient atmosphere.

6. Ethanol 300g + Lithium hydroxide monohydrate 2.1g + Cobalt nitrate hexahydrate 14.6g  
(atomic-ratio Li/Co(mole ratio) =1.0)
7. The mixture + Lithium nickel multiple oxide 92.7g  
(atomic-ratio Co/Ni(mole ratio) =0.05)
8. Dry the dispersion with Spray dryer which the temperature of the spray exit is 100 degree C.
9. Calcinate it at 700 degree C for 1 h in oxygen ambient atmosphere.

**[Example 5]**

1. Lithium-hydroxide monohydrates 83.9g + Nickel hydroxide 185.4g  
(atomic-ratio Li/Ni(mole ratio) =1.0)
2. Mill and mix it with ball mill.
3. Dry at 150 degree C for 12 h.
4. The mixture was calcinated at 750 degree C for 5 h in oxygen ambient atmosphere.
5. Mill it for 1 h with ball mill in nitrogen ambient atmosphere.
6. Ethanol 300g + Lithium nitrate 3.4g + Cobalt nitrate hexahydrate 14.6g  
(atomic-ratio Li/Co(mole ratio) =1.0)
7. The mixture + Lithium nickel multiple oxide 92.7g  
(atomic-ratio Co/Ni(mole ratio) =0.05)
8. Dry the dispersion with Spray dryer which the temperature of the spray exit is 100 degree C.
9. Calcinate it at 700 degree C for 1 h in oxygen ambient atmosphere.

[Table 1]

	Initial capacity	Capacity at 50 cycles
	初期放電容量 (mAh/g)	充放電 50サイクル後の 放電容量 (mAh/g)
実施例 1	168	152
実施例 2	171	152
実施例 3	160	149
実施例 4	158	150
実施例 5	155	142
比較例 1	142	121
比較例 2	138	121
比較例 3	115	106
比較例 4	133	117

The examples of comparison  
Non-coated sample